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ABSTRACT

To determine the efficacy of auditory, visual and combined auditory-visual modes of presenting verbal material, 12 first-grade, 12 third-grade and 12 fifth-grade children were tested on paired associates lists presented under visual, auditory and combined auditory-visual conditions. Pictures rather than printed words were used as visual stimuli to control for effects of differences in reading ability across grade levels. Performance of all groups under visual and combined auditory-visual modes of presentation was significantly higher than that attained under the auditory condition. The imagery inducing quality of pictures was offered as a possible explanation for superior learning under visual and auditory-visual conditions. Differences with previous findings were ascribed to poor control in other studies of the effects of reading skill in visual learning conditions. (Author)

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AUDITORY AND VISUAL LEARNING IN FIRST-, THIRD-, AND FIFTH-GRADE CHILDREN[1,2]

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RESEARCH AND DEVELOPMENT CENTER
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The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

To determine the efficacy of auditory, visual and combined auditory-visual modes of presenting verbal material, 12 first grade, 12 third grade and 12 fifth grade children were tested on paired associates lists presented under visual, auditory and combined auditory-visual conditions. Pictures rather than printed words were used as visual stimuli to control for effects of differences in reading ability across grade levels. Performance of all groups under visual and combined auditory-visual modes of presentation was significantly higher ($p < .01$) than that attained under the auditory condition. The imagery inducing quality of pictures was offered as a possible explanation for superior learning under visual and auditory-visual conditions. Differences with previous findings were ascribed to poor control in other studies of the effects of reading skill in visual learning conditions.

AUDITORY AND VISUAL LEARNING IN FIRST-, THIRD-, AND FIFTH-GRADE CHILDREN[1,2]

Robert H. Bruininks Charlotte Clark

Learning of verbal concepts depends primarily on the comprehension of material presented via auditory and visual sensory channels. It is often presumed that younger children rely principally upon audition in the acquisition of information, whereas older children and adults exhibit increasing dependence upon vision coincident with the development and refinement of reading skills. As yet unresolved is the issue of whether a visual presentation is more efficient than an auditory presentation of verbal material for young children. Currently, methods of presenting learning materials to children are based ostensibly upon considerations of instructional convenience, rather than being based upon individual preferences for learning. Identifying sensory preferences for learning might be of importance in structuring many learning experiences for young children--particularly those in the area of language arts (e.g., reading, listening, etc.).

Interest in the relative efficacy of the auditory and visual sense receptors in acquiring verbal information has been a long-standing research interest among educators and psychologists (cf. Day and Beach, 1950; McGeoch and Irion, 1952). Early research in this area focused primarily upon the apprehension by adults of prose material presented via auditory and visual stimulus modes. A number of general trends seem to emerge in examining these early studies: a) a combined auditory and visual presentation appears

more effective than a unisensory presentation; b) visual presentation appears the more effective for learners with increased intellectual and reading skills; and c) the relative effectiveness of a visual presentation increases with age from a level of inferiority among young children to a level of superiority among older students and adults (Day and Beach, 1950).

Several recent studies have reported on the subject of mode of stimulus presentation which employ subjects across a wide range as well as a variety of stimulus materials. Very few investigators, however, have studied this issue with young children in the early primary grades (K through 3), nor have they identified differences in the learning patterns of boys and girls. It appears from the available data that an auditory presentation results in more efficient learning for young children (below 10 years in age), while a visual presentation generally results in greater learning among older children and adults when printed words are employed as visual stimulus material (Beery, 1968; Budoff & Quinlan, 1964; Cooper & Gaeth, 1967; Carterette & Jones, 1967; Shapiro, 1966). In studies using pictures rather than printed words as visual stimulus material, however, a visual presentation has resulted in comparable or superior performance to an aural exposure with young children (Hall, 1969; Hill & Hecker, 1966). Some evidence is available which suggests that a combined auditory-visual presentation facilitates learning (cf. Day & Beach, 1950), while other studies report no advantage in learning through a combined presentation (Hill & Hecker, 1966; Katz & Deutsch, 1964).

The age differences reported in auditory and visual learning performance may be ascribed to habitual patterns of usage, rather than to the intrinsic stimulus value of different modes of presentation. Investigators have incorrectly assumed that young children encounter little difficulty associating printed words if they are able to recognize them in isolation at the outset of an experiment. As Roberts and Lunzer (1968) have noted, however, "the perceptual identification of a word is simply the reduction of whatever uncertainty exists at the moment of perception in respect to what the word is (p. 207)." With young children who are engaged in the process of learning to read, considerable uncertainty often precedes the recognition of words in context or in isolation. Uncertainty in the recognition of words is reduced substantially as a child's word identification skills are refined and become automatized. In many of the paired associates studies previously cited, young children in contrast to adults undoubtedly had to reduce considerable uncertainty in the identification of printed words before they could achieve correct associations of printed stimuli. The task of recognizing and associating printed words is undoubtedly more difficult for young children than it is for older children and adults. By confounding the effects of reading skill skill with the results from studies on mode of stimulus presentation, it is likely that investigators have often reached erroneous conclusions regarding the relative efficacy of auditory and visual presentations of verbal materials. This conclusion is also supported by the results of several studies which have reported

greater learning efficiency among subjects of widely varying ages when using pictorial as opposed to printed words in a paired associates paradigm (Hale, 1970; Hughes, 1968; Jenkins, Neale and Deno, 1967; Paivio & Yarmey, 1966; Smelser, 1969).

With level of reading ability confounding the results of previous studies, it is difficult to identify distinct sensory learning patterns among children and adults or to interpret age and sex differences in studies of auditory and visual learning. Moreover, what advantage may accrue from adding cues through a combined auditory-visual presentation, as compared to a unisensory presentation, is undetermined. The purpose of the present study is to test the efficacy of auditory, visual, and combined auditory-visual modes of presenting verbal material for first-grade, third-grade, and fifth-grade children. Pictures rather than printed words were used as visual stimulus material to control for the effects of differences in reading skills across grade levels. It was predicted that: a) older (fifth-grade) children would profit more than younger children from a visual presentation, b) a combined auditory-visual approach would yield higher learning scores than auditory and visual presentations alone, and c) no significant differences would emerge between boys and girls in patterns of auditory and visual learning.

Method

Subjects

Subjects were first-, third-, and fifth-grade middle-class Caucasian children who attended a suburban school in North St. Paul,

Minnesota. Subjects were selected if their IQ scores on the Primary Mental Abilities Tests, Forms K-1, 2-4, and 4-6 (Thurstone & Thurstone, 1962) ranged between 90 and 112, and on the basis of socio-economic status information gathered from school records. Children were eligible for inclusion in the study if they had less than three siblings, and if the occupation of the main wage earner of the family fell above the fifth level (skilled trades, managerial, professional) on the Revised Scale for Rating Occupations (Warner, Meeker & Eells, 1949).

One group of six boys and six girls meeting the above criteria was constituted at each grade level. The first-grade subjects had a mean CA of 6 years, 11 months, and a mean IQ of 104. The third-grade group had a mean CA of 9 years and a mean IQ of 102. The fifth-grade group had a mean CA of 11 years, and a mean IQ of 104.

Materials

The paired-associates lists consisted of 48 concrete nouns selected from the Thorndike and Lorge (1944) word list. Frequency of occurrence of the nouns ranged from eight per million to 100 per million words in print, with the majority (30) of the words falling within the range of 50 to 100 per million words in print. Nouns were paired so as to maximize their conceptual dissimilarity, hence minimizing their associative value. Table 1 presented the list of paired nouns.

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Table 1

Lists of Paired Nouns

List I			List II			List III		
purse	--	carrot	candle	--	train	fish	--	plane
iron	--	window	Indian	--	bell	refrigerator	--	tree
bread	--	chair	cup	--	bird	fan	--	turtle
dress	--	squirrel	rabbit	--	car	gun	--	house
flower	--	boat	clock	--	glasses	sweater	--	knife
umbrella	--	telephone	bus	--	doll	table	--	elephant
book	--	cat	pin	--	truck	tent	--	butterfly
horse	--	stove	bug	--	hat	dog	--	flag

Stimulus materials for the visual presentation consisted of line drawings mounted on 3 x 5 cards. The stimulus item was mounted on the left half and the response item on the right half of each card. Additional cards were prepared for the test phase by mounting the stimulus picture on the left half of the card and leaving the right half of the card blank.

The pairs of nouns were randomly assigned to one of three lists so that each list contained eight pairs. The order of word pairs was randomized within both "study" and "test" lists.

Procedure

Children were tested individually on three different paired-associates tasks in a small room. For three consecutive days, the subject was presented a new list in a different condition--a visual presentation (V), an auditory presentation (A), and a combined auditory/visual presentation (A/V)--using a study-test or block method of presentation. The order of conditions and lists within conditions was randomized in a counter-balanced arrangement so that each list and condition appeared in each position an equal number of times. Table 2 shows the order of presentation for conditions and lists.

The subject was brought to the experimental room by the examiner who talked with the child on the way to the room about various things unrelated to the learning task. On reaching the experimental

Table 2

Order of Presentation of Conditions by Lists

Order	1st	2nd	3rd
I	Auditory---------->	Visual---------->	Auditory/Visual
	List 1	List 2	List 3
II	Visual---------->	Auditory/Visual----->	Auditory
	List 3	List 1	List 2
III	Auditory/Visual------->	Auditory---------->	Visual
	List 2	List 3	List 1

room, the child was seated opposite the examiner who read the following instructions according to the particular method of presentation:

> I'm going to show you a lot of pictures. I will show you them two at a time, like this (E held up sample card). I want you to try to remember these pictures together, because later I will show you just one and will ask you to tell me what picture you saw with it on the card. You will have plenty of tries to get them right, but look carefully each time and try to remember the two pictures together.

In the A and A/V conditions the examiner used approximately the same wording but told the subject that he would either hear some word pairs (A), or see pictures and hear word pairs simultaneously (A/V). If at any time during the learning phase the subject said the name of a picture, or repeated the noun pairs, he was told not to say anything aloud and, in the V and A/V conditions, only to look at the cards.

Lists were presented in all three conditions at the rate of one pair every six seconds with a six-second inter-trial interval. In the V condition, the pair was presented simultaneously for three seconds then removed from view. Three seconds elapsed before presentation of the next pair. The word pairs in the A condition were presented at the rate of one word per second with a one-second pause between stimulus and response items, followed by a three-second interval between pairs. In the A/V condition, the auditory presentation was superimposed on the visual presentation using the same time sequence.

During the test phase, subjects were presented stimulus items

using the V, A, or A/V procedures. Before each test trial the following instructions were read:

> Now I am going to show you just one picture and I want you to tell me what picture you saw with it on the card. Ready?

The examiner used approximately the same wording as above in the A and A/V conditions, but told the subject that he would hear only one word and was to tell what word went with it (A), or he was to tell what he had seen and heard with it before (A/V).

Test cards were presented at the rate of one stimulus item every six seconds. At no time in the test condition was the subject informed of the correctness or incorrectness of his response. Criterion was two perfect successive errorless trials to a maximum of ten trials. The learning scores consisted of the number of correct responses in ten trials.

Results

Means and standard deviations on learning and IQ scores of first-, third-, and fifth-grade children are in Table 3. Table 4 presents a mixed analysis of variance on learning scores (grade x sex x order x presentation mode). The .05 level of confidence was used to evaluate the statistical significance of all findings.

Table 4 indicates that only the main effect of presentation mode produced significant differences. Differences between means

Table 3

Descriptive Statistics on Learning and IQ Scores

Groups	Auditory Correct		Visual Correct		Aud/Vis. Correct		PMA Verb IQ		PMA Total IQ	
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
First Grade										
Boys	22.7	19.0	48.7	18.8	47.2	12.6	96.7	11.0	102.0	7.2
Girls	26.0	19.5	46.3	17.2	52.3	14.6	103.7	8.5	106.3	3.9
Total	24.3	18.5	47.5	17.2	49.8	13.3	100.2	10.0	104.2	6.0
Third Grade										
Boys	25.0	16.9	42.8	13.9	52.3	16.5	102.2	9.3	103.3	5.6
Girls	41.2	23.7	42.8	29.5	41.2	27.1	98.5	8.3	100.5	3.8
Total	33.1	21.4	42.8	22.0	46.7	22.2	100.3	8.6	101.9	4.8
Fifth Grade										
Boys	41.3	20.8	56.7	17.3	61.0	7.8	105.2	10.3	104.0	7.9
Girls	32.0	23.9	59.8	9.6	54.3	9.0	104.5	8.0	104.5	9.9
Total	36.7	21.9	58.3	13.4	57.7	8.7	104.8	8.8	104.3	8.5
Totals										
Boys	29.7	19.0	49.4	16.7	53.5	12.8	101.4	10.2	103.1	7.0
Girls	33.1	22.4	49.6	20.5	49.3	18.5	102.2	8.3	103.8	6.5
Total	31.4	20.7	49.5	17.9	51.4	15.8	101.8	9.2	103.5	6.6

Table 4

Analysis of Variance
on Learning Scores

Source	df	MS	F
Between Subjects			
Grade Level (A)	2	1238.12	1.56
Sex (B)	1	.93	0.00
Order (C)	2	45.45	0.06
A x B	2	113.40	0.14
A x C	4	1313.77	1.66
B x C	2	275.73	0.35
A x B x C	4	353.83	0.45
Error (b)	18	789.83	1.00
Within Subjects			
Presentation Mode (D)	2	4407.62	29.40*
A x D	4	188.31	1.25
B x D	2	131.79	0.87
C x D	4	106.44	0.71
A x B x D	4	305.34	2.03
A x C x D	8	227.13	1.51
B x C x D	4	140.55	0.94
A x B x C x D	8	172.73	1.15
Error (W)	36	149.92	1.00

* $p < .01$

for this factor were analyzed by using Tukey's HSD test (Kirk, 1968). Analysis of overall differences among conditions revealed that performance of the total group under V and A/V modes of presentation was significantly higher ($p < .01$) than that attained under the A condition. None of the other main effects (grade level, sex, and order) or interactions were statistically significant.

Discussion

It was predicted that (1) older children would profit more from a V than an A presentation of verbal material, (2) a combined A/V approach would yield higher learning scores than auditory and visual presentations alone, and (3) no significant differences would emerge between boys and girls in patterns of auditory and visual learning. The predictions were not confirmed that older children would profit more from a V than an A presentation and that the combined A/V presentation would yield the highest learning scores. Children at all three grade levels (first, third, and fifth) performed significantly better under the combined A/V and V conditions in comparison to an A presentation of word pairs. No significant difference was obtained between V and A/V conditions. This outcome is at variance with those of several earlier studies which report greater learning under a combined A/V presentation (Day & Beach, 1950).

The findings of the present study which indicate that a V presentation was superior to an A presentaion appear to be inconsistent with those of several previous studies (Budoff & Quinlan, 1964;

Carterette & Jones, 1967; Day & Beach, 1950; Shapiro, 1966). Most previous studies have reported higher learning performance for young children under an auditory presentation, while visual conditions result in better learning among older children and adults. Much of this discrepancy among findings on auditory and visual learning may be ascribable to the prevalent use of printed words as visual stimulus material. Even though young children could recognize the printed words used as visual stimuli in these studies, there is still considerable uncertainty for naive readers in the identification of even simple words (Roberts & Lunzer, 1968). Since word identification for older normal children and adults is invariably instantaneous and involves little uncertainty, use of printed words as visual stimulus material undoubtedly creates greater difficulty for young children than for more sophisticated readers. When pictures are employed as visual stimulus material, however, young children appear to learn more efficiently than when an auditory stimulus is used for the same or comparable materials (Hall, 1969; Hill & Hecker, 1966; Katz & Deutsch, 1964).

Superior performance of all three age groups in a V condition employing pictures may be ascribed to the nature of the stimulus materials and/or the nature of the auditory and visual sensory modalities. One possible explanation for the higher learning performance in the V and combined A/V conditions as compared to the A condition is that pictures <u>per se</u> may induce greater visual imagery (mental pictures) which facilitate association of stimulus

and response items (Reese, 1970). Common to both the V and A/V conditions was the use of pictorial representations of concrete nouns as stimulus material. Examination of Table 1 quickly reveals that the pairs of concrete nouns employed as learning materials readily lend themselves to the evocation of visual images and are high in "imagery" content.

A number of recent studies on imagery in verbal learning have found that learning performance of children and adults is superior under conditions which encourage imagery of paired associates items--i.e., when pictures rather than printed words or aurally presented words are used as stimuli (cf. Rohwer, 1970; Paivio, 1970). Imagery particularly aids learning verbal materials when high imagery materials (concrete nouns) and pictures are employed on the stimulus side (Dilley & Paivio, 1968). Paivio (1970) has speculated that the visual system with its capacity for spatial, as opposed to tempora' representation may better lend itself to the associati n and stora e of word pairs as an organized unit. While the subjects in the present study were not given explicit instructions to visualize interactions between stimulus and response items in either the A, V, or A/V conditions, it is likely that they were more inclined to employ imagery in developing correct associations under conditions involving pictorial as opposed to comparable verbal materials presented auditorily. Judging from the results of previous studies on auditory and visual learning, an A or verbal presentation may lend itself more to the evocation of images

only when printed words were used as visual stimulus material. While little definitive data are available on this issue, imagery rather than mode of stimulus presentation *per se* may provide a better explanation for superior learning performance in conditions using pictures as visual stimulus materials.

The unique aspects of audition and vision could provide another plausible explanation for the present findings. Learning via the sense modality of vision affords continuous review of material, whereas auditory stimuli is presented temporally and precludes continuous inspection. In the V condition stimuli were presented simultaneously for a period of 3 seconds; the auditorily presented word pairs were presented for the same duration but in temporal sequence separated by a 1-second intrapair interval. To test the tenability of the assumption that the simultaneity of visual perception was responsible for the superior performance in the V and A/V conditions, a pilot study of six first-grade and four third-grade subjects was conducted with the same pictorial stimuli under simultaneous and sequential methods of presentation. The simultaneous presentation replicated the visual condition used in the experiment; the sequential presentation repeated the format employed in the auditory condition except pictures were used as stimulus materials. All other procedures were identical to those employed in the original study. The findings of this study revealed no significant difference in the number of correct responses between the simultaneous and sequential formats of presentation ($t = 1.04$). Based on the

limited data of this study, it does not appear that the superiority of the V and combined A/V presentations is attributable to the simultaneity and continuous review afforded by vision.

Applications of these findings derived from an experimental setting to instructional programs for young children must be cautiously entertained. It is interesting to note that research evidence on elementary school children and pupils in special classes for the mentally retarded reveals that the major portion of a child's school day is spent in listening (Hurley, 1967; Markgraf, 1966; Wilt, 1966). While many children experience some visual input in listening, the amoung of time children listen may emanate from the prevailing emphasis on group instruction as well as from the assumption that young children apprehend verbal material better through an aural than a visual presentation. The results of the present study suggest that since young children learn to recall and associate verbal materials better through a pictorial or a multi-sensory auditory-pictorial presentation, greater attention should be given to the systematic inclusion of opportunities for visual learning/or combined auditory-visual learning for young children. Listening as an approach to learning in elementary school classrooms should be supplemented as much as possible with correlated pictorial and other visual materials.

One example of an attempt to induce a greater pictorial emphasis in teaching reading to young children has been presented recently by Woodcock (1968). In this study, two small groups of preschool disadvantaged children were taught to identify a set of 19 concrete

Table 3

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Groups	Auditory Correct		Visual Correct		Aud/Vis. Correct		PMA Verb IQ		PMA Total IQ	
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First Grade										
Boys	22.7	19.0	48.7	18.8	47.2	12.6	96.7	11.0	102.0	7.2
Girls	26.0	19.5	46.3	17.2	52.3	14.6	103.7	8.5	106.3	3.9
Total	24.3	18.5	47.5	17.2	49.8	13.3	100.2	10.0	104.2	6.0
Third Grade										
Boys	25.0	16.9	42.8	13.9	52.3	16.5	102.2	9.3	103.3	5.6
Girls	41.2	23.7	42.8	29.5	41.2	27.1	98.5	8.3	100.5	3.8
Total	33.1	21.4	42.8	22.0	46.7	22.2	100.3	8.6	101.9	4.8
Fifth Grade										
Boys	41.3	20.8	56.7	17.3	61.0	7.8	105.2	10.3	104.0	7.9
Girls	32.0	23.9	59.8	9.6	54.3	9.0	104.5	8.0	104.5	9.9
Total	36.7	21.9	58.3	13.4	57.7	8.7	104.8	8.8	104.3	8.5
Totals										
Boys	29.7	19.0	49.4	16.7	53.5	12.8	101.4	10.2	103.1	7.0
Girls	33.1	22.4	49.6	20.5	49.3	18.5	102.2	8.3	103.8	6.5
Total	31.4	20.7	49.5	17.9	51.4	15.8	101.8	9.2	103.5	6.6

Table 4

Analysis of Variance
on Learning Scores

Source	df	MS	F
Between Subjects			
Grade Level (A)	2	1238.12	1.56
Sex (B)	1	.93	0.00
Order (C)	2	45.45	0.06
A x B	2	113.40	0.14
A x C	4	1313.77	1.66
B x C	2	275.73	0.35
A x B x C	4	353.83	0.45
Error (b)	18	789.83	1.00
Within Subjects			
Presentation Mode (D)	2	4407.62	29.40*
A x D	4	188.31	1.25
B x D	2	131.79	0.87
C x D	4	106.44	0.71
A x B x D	4	305.34	2.03
A x C x D	8	227.13	1.51
B x C x D	4	140.55	0.94
A x B x C x D	8	172.73	1.15
Error (W)	36	149.92	1.00

* $p < .01$

words presented either as printed words or as rebuses (pictures). The results of the study demonstrated that learning to read "rebuses" was significantly easier than learning the same words written in traditional orthography. Woodcock, Clark and Davies (1968) have developed an early reading program with rebus (pictorial) symbols in an attempt to reduce the learning load which confronts young children in reading (e.g., learning that symbols represent meaning, left-to-right sequence, etc.).

Aside from recommending increased efforts to develop instructional strategies which capitalize on visual (pictorial) learning, further research must endeavor to explain why young children comprehend verbal material easier through a pictorial than an aural presentation. While empirical evidence abounds in this area, theoretical explanations for sensory learning patterns of children and adults are poorly developed, if developed at all. Theoretical and empirical advances in the area of imagery in children's learning appear promising, and may provide the structure and focus required for the effective improvement of instructional materials and learning experiences for children and adults.

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Footnotes

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(Place of publication shown in parentheses where applicable)

1. R. Riegel & A. Taylor. Strategies in the classroom: A summer remedial program for young handicapped children. Occasional Paper #14. March 1973.

2. D. Moores. Early childhood special education for the hearing handicapped. Occasional Paper #13. February 1973.

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